DOCUMENT RESUME

ED 351 556 CE 062 422

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TITLE How Convincing Is the Evidence Linking Education and Income?
INSTITUTION Minnesota Univ., Minneapolis. Industrial Relations Center.
PUB DATE 91
NOTE 23p.; Fourth Annual George Seltzer Distinguished Lecture.
AVAILABLE FROM Publications, Industrial Relations Center, University of Minnesota, 271 - 19th Avenue South, Minneapolis, MN 55455.
PUB TYPE Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Ability; *Academic Achievement; *Educational Attainment; *Educational Benefits; *Educational Status Comparison; Education Work Relationship; Family Characteristics; *Income; Research Methodology; Salary Wage Differentials; Vocational Education

ABSTRACT

Recent research has studied the link between schooling and income. Evidence indicates the strong relationship found between level of education and lifetime earnings levels. Labor economists have designed studies and measured educational outcomes to differentiate between earnings associated with innate ability and earnings associated with investments in education. A series of studies to control ability using intrafamily measures, including surveys of fathers, sons, brothers, and twins attending an annual convention of twins, helps to identify the relatively robust finding that returns to education average around 10 percent. Other "natural" experiments using time of year of birth and compulsory school attendance laws and draft lottery numbers from the Vietnam War era also shed light on the magnitude of educational effects and support the 10 percent figure. (Appendixes include eight footnotes and three figures.) (YLB)

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Orley Ashenfelter

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The George Seltzer Distinguished Lecture
Industrial Relations Center
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How Convincing is the Evidence Linking Education and Income?

Orley Ashenfelter

The George Seltzer Distinguished Lecture
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PREFACE

The first four annual George Seltzer Distinguished Lectures have developed the theme, "The American Dream: Education and Work." This year's lecture, delivered by Orley Ashenfelter, Professor of Economics and Director of the Industrial Relations Section, Princeton University, is entitled "How Convincing is the Evidence Linking Education and Income?"

In his lecture, Professor Ashenfelter outlines a basic human capital model and presents evidence indicating the strong relationship found between level of education and lifetime earnings levels. He then proceeds to explain how labor economists have designed studies and measured educational outcomes to differentiate between earnings associated with innate ability and earnings associated with investments in education.

A series of intriguing studies to control ability using intra-family measures, including a survey of twins attending an annual convention of twins, helps to identify the relatively robust finding that returns to education average around 10%. Other "natural" experiments using time of year of birth and compulsory school attendance laws, and draft lottery numbers from the Vietnam War era also shed light on the magnitude of educational effects and support the 10% figure.

The lecture accomplishes two objectives: first to point out that the evidence of an education-income linkage is convincing; and second, to introduce the reader to the increasingly sophisticated research strategies that enable us to increase our confidence about the robustness of the findings.

Professor Ashenfelter's visit involved not only this lecture, but also included meetings and discussions with faculty members and doctoral students. His

generosity in visiting with us provided an additional level of enrichment consistent with the goals of the Seltzer lectureship.

As have previous lectures, this year's was organized and coordinated by Professor Mahmood Zaidi; Donna D'Andrea, the Administrative Director of the Industrial Relations Center; and Jonathan Seltzer. Their efforts substantially contributed to the quality of the lecture visit activities.

The Annual George Seltzer Distinguished Lecture is made possible by various private contributions and University matching funds on the occasion of the retirement of George Seltzer from the University of Minnesota in 1988 and in support of the continuing enrichment of the curriculum and research of the Industrial Relations Graduate Program with which Dr. Seltzer has been affiliated for some 35 years.

How Convincing is the Evidence Linking Education and Income[1]

Orley Ashenfelter[2,3]

The George Seltzer Distinguished Lecture
Industrial Relations Center
University of Minnesota

My purpose in this lecture is to review the research of economists who have studied the role of education as an investment. I think that most educators, including myself, would prefer that this issue never had to be raised. After all, as educators we typically pursue learning because we enjoy it. Why, then, shouldn't everyone else do the same thing?

As usual, the answer has to do with the limits on our resources. Most people apparently have many other things they would prefer to do with their money than spend it on education. Spending on schools and colleges must compete with other demands on our resources. If more and better education increases the incomes of those who receive the education, then there is surely a stronger argument for making educational expenditures than would otherwise be the case. In a capitalist economy, where productivity is identified with earnings, the case is even stronger, because the increased earnings associated with more and better education is the equivalent of greater output for society. If, on the other hand, education does not increase the incomes of its recipients, then it is like any other consumer good that must compete for our attention.

In recent years the value of our expenditures on schools and colleges has become a source of considerable controversy. At one level every politician expresses a belief in the importance of the American system of education as an investment in the future. For example, Senator William Bradley introduced his recent proposal for "Self-reliance Scholarships" by stating (in the Congressional Record, July 25, 1991) "...a college graduate will earn about 60 percent more than someone with just a high school diploma. Our economy rewards college graduates because we need their skills so deeply."

But there is nothing that brings out education's detractors like proposals to spend more money. The most famous recent critic of school expenditures has been William Bennett, who was quoted (in USA Today) when he was US Secretary of Education three years ago as saying that "Money doesn't cure school problems..... We cannot show a strong, positive correlation between spending more and getting a better result." Bennett's comments were based on a survey article by economist Eric Hanushek who concluded, "...increased expenditures by themselves offer no overall promise for improving education. Further, the components of these expenditures offer little promise. Thus, a simple recommendation: Stop requiring and paying for things that do not matter." Such controversy suggests that a review of the evidence on the link between education and income may be of more than academic interest at this time.

I must also admit at the outset that I have an ulterior motive in selecting this topic for discussion. The recent research on the link between schooling and income provides a fascinating example of the new emphasis on credibility in empirical economics. This new research style began with the study of problems

in the labor market, but it has also influenced other social scientists and even some policy makers. As we shall see, this research style emphasizes the importance of collecting new data and of finding and creating actual or natural experiments that will permit us to make more credible inferences about the effect of public policy changes.

1. Schooling and Income: The Simple Relationship

No one doubts that college graduates earn more than high school graduates, or that high school graduates earn more than high school dropouts. In 1987, for example, the average weekly earnings of white males between the ages of 26 and 65 who had 16 years of education was some 40% to 50% greater than the average weekly earnings of those with exactly 12 years of schooling.

Figure 1 shows the relationship between weekly earnings and age for high school graduates (H) and college graduates (C) in 1987. It is obvious that college graduates earn more than high school graduates at all ages, but this difference is especially great in the years of middle age.

But how are we to interpret these differences in earnings? Is it not possible that those who obtain high school or college degrees would earn more than other workers even if they had not taken the time and spent the money to obtain them?

2. Schooling and Income: The Ideal Experiment

In principle the only way to answer this question definitively is to perform an experiment. In such an

experiment different groups of students would be randomly assigned to different educational levels without regard to their ability or general background. Years later we would compare the incomes of these students. On average the only differences among the students would be the level of their schooling. Contrasts of the earnings of the various groups would, with a large enough sample, provide an entirely credible estimate of the effect of schooling on earnings.

Of course, the experiment I have described has not been performed, and so we do not have any entirely credible estimates of the effect of schooling on earnings. Some people will object that such an experiment would, even in principle, be morally objectionable because it would deny a potentially valuable education to those who might otherwise have obtained it. The way to meet this objection, of course, is to make sure that no one is denied access to anything. For example, in most developing countries inadequate finances make it impossible to educate all those students who wish to attend secondary schools. If students were admitted to secondary schools, in part, on a randomized basis it would be possible to perform a credible experiment that would not be objectionable. When people must be denied access to educational opportunities in any case, why not use a randomized allocation system so that we may learn from their experiences?

Although many people are not aware of it, there has been a quiet revolution in the extent to which randomized trials have been used to evaluate the role of education and training in the determination of earnings in the U.S. The National Supported Work Demonstration in the mid-1970s showed that worker training programs could be implemented using a classical randomized design and that the resulting data provided very credible evidence of the success (and failures) of

these programs. Indeed, the results from these classical experiments have served as an impetus to develop more credible econometric methods for evaluating the impact of training programs on worker earnings.[4]

Despite these advances, however, we do not yet have any evidence on the role of education in the determination of earnings that is based on the classical experimental methods. Instead, we must necessarily look elsewhere for convincing non-experimental evidence. One way to look for this evidence is to use comparisons between workers who have similar genetic and family backgrounds, but who differ in educational levels. A systematic correlation between the educational differences and income differences of such workers is one place to look for evidence of the link between income and schooling.

3. Intra-Family Schooling-Income Relations: Fathers, Sons, Brothers

In some recent research David Zimmerman and I have studied differences in the schooling level of fathers from the schooling levels of their sons and the relationship of these schooling differences to income differences between fathers and sons. Figure 2 is a scatter diagram that shows this relationship. On the vertical axis is a measure (in ratio or logarithmic scale) of the difference between the hourly wage rate of each father and his son. On the horizontal axis is the difference between the years of schooling of the father and his son. Each point on the diagram represents one father-son pair, and there are 332 such pairs in the National Longitudinal Survey that we have used.

As one would expect in an economy where the average schooling level has been growing, fathers have about four fewer years of schooling than sons. As one would

also expect in a society which has imperfect generational mobility, fathers with higher education levels tend to have sons with higher education levels. (The correlation coefficient is about .4.) This suggests the possibility that the simple correlation between the income and schooling of the sons may be the result of the fact that better educated sons also have better connected fathers. If this were the only reason for the correlation between the income and schooling of sons we would know that the returns to schooling were negligible.

As Figure 2 indicates, however, this cannot be the entire story. After all, the diagram indicates that there still remains a substantial correlation between the difference in the education level of the father from the son and the difference in their incomes. If we compare two sons who both have well educated fathers, the son who is better educated has the higher income. In short, more education for the son increases the son's income regardless of the father's education level. (The slope of the best fitting line in these data indicates that a one year difference in the education levels of father and son translates into about a 5% difference in wage rates.) This implies that the returns to schooling are not simply a result of the fact that sons with more schooling have fathers with more schooling too.

Zimmerman and I have also studied the correlation of differences in the incomes of brothers with differences in the schooling level of brothers. When we compare two brothers from the same family we find that the better educated brother's income averages about 5% more for each extra year of schooling he has. In short, although some part of the correlation between income and schooling may be due to family background characteristics, the intra-family correlation between income and schooling indicates that most of the

relationship between income and schooling must be due to something else.

4. Intra-Family Schooling-Income Relations: Identical Twins

Although there have been surprisingly few attempts to measure the returns to schooling by the comparison of education and income differences within families, there is one study of identical twins which remains the most important effort to date. In this work Behrman, Hrubec, Taubman, and Wales find that the simple relationship between schooling and income in their data suggests that each additional year of education adds about 8% to the income of a twin. However, a comparison of the twins alone indicates that the better educated of two twins earns no more than 2% extra for each additional year of schooling. In short, Behrman, Hrubec, Taubman, and Wales find that the differences in education levels between identical twins are virtually uncorrelated with the differences in their income levels. This finding, if correct, is the single most important piece of empirical evidence suggesting that the observed relationship between schooling and income may be a result of genetic or family background differences and is not a result of any real increase in the skills of better educated workers.

The Behrman, et al. research has been criticized on the grounds that schooling differences between twins are likely to be very small. As a result, the measured schooling differences between twins may be a result of measurement error.[5] To see the effect that this will have on the results of a comparison of schooling differences with earnings differences, consider the case where all twins have identical education levels. In this situation any measured differences in the education levels of twins will be entirely a result of measurement

error. The result will be that measured schooling differences will be unrelated to earnings differences. Instead of indicating that true schooling differences are unrelated to earnings differences, this result would only indicate that the data on twins do not provide the right natural experiment for examining the issue. In sum, the Behrman, et al. results may be consistent with a considerable effect of schooling on earnings, but this issue cannot be resolved at the present time because there is no independent measure of the error in the Behrman, et al. survey data.

It appears that the only way to resolve this issue is to obtain new data on twins and to attempt some independent validation of the reliability of the measured education data. During the past summer my colleague Alan Krueger and I organized a team of graduate students to collect new data on twins in order to settle this issue. To do this at reasonable cost we participated in the research group that gathered data from the twins who assemble each year for the National Twins Festival in Twinsburg, Ohio. Much to our surprise we were able to administer the Current Population Survey to nearly 500 twins in a brief, but intensive, three day period. In order to validate the data on the education level of each twin we separated the twins for the purposes of our interviews and asked each twin about his (or her) own education level as well as the education level of his (or her) twin.

Our main findings are displayed in Figure 3. As before, this is a scatter diagram where each point represents a single pair of twins. The vertical axis represents the difference (in ratio terms) between the incomes of identical twins, while the horizontal axis represents the difference between the schooling levels of the twins. As one would expect, the diagram indicates (by the concentration of observations at zero on the horizontal

axis) that in the most typical case the twins have the same education level. The diagram also makes clear that there is a considerable correlation between income differences and schooling differences. In these data the better educated twin earns about 7% more for each extra year he (or she) attains compared to his (or her) twin.

We also find considerable evidence of measurement error in the data on education levels. (Overall, the schooling level reported by one twin has a correlation of about .9 with the schooling level reported by the other twin.) Using a standard procedure, Krueger and I find that the return to schooling estimated by a comparison of intra-family education differences for twins may be as small as one-half the return that would be estimated with data that contained no measurement error. In short, the results of our new study of twins indicates that, on average, an additional year of education has a very sizeable effect on the earnings of twins and may be as large as 14% for each additional year.

5. Schooling and Income: Natural Experiments

The evidence from the study of intra-family differences in education and their correlation with intra-family differences in income strongly supports the hypothesis that additional schooling is responsible for increases in worker earnings. Despite the consistency of this evidence, none of it represents the equivalent of an ideal experiment. In the past few years Joshua Angrist and Alan Krueger have attempted to find a natural experiment that would provide the kind of information that an ideal experiment would provide. To do this they have attempted to locate exogenous events that might be expected to alter the schooling decisions of some people, but which would not be expected to

independently alter their income. Naturally, finding such events is difficult.

In one paper Angrist and Krueger[6] observe that there is a relationship between the quarter in which an individual is born and the mean level of schooling that the individual attains. Angrist and Krueger argue that compulsory schooling laws are a natural explanation for why individuals born in the first quarter of the year attain fewer years of education than individuals born later in the year. They observe that school districts typically require that students turn age six by January 1st of the year they enter school. Thus, students born early in the year enter school at an older age. Since compulsory schooling laws permit students to drop out as soon as they attain age 16 students born early in the year may drop out of school with fewer years completed than is the case for those born later in the year.

In fact, Angrist and Krueger find that workers born in the first quarter of the year typically average about one-tenth year less schooling than workers that are born in the other three quarters of the year. Remarkably, these same workers also typically earn about one percent less per week than other workers. In short, the accident of being born in the first quarter of the year is typically associated with a lower schooling level and a lower earnings level. The implied return to schooling is about 10% per additional year of education attained.

Of course, compulsory schooling laws affect primarily high school completion rates and may be of little assistance in evaluating the returns to a college education. In a subsequent paper Angrist and Krueger[7] explore the role that the Vietnam era draft lottery had on education levels. During the Vietnam era a public

lottery was used to randomly assign eligibility status for the draft to different birth dates during the year. Individuals were thus eligible for the draft according to their birth dates. Angrist and Krueger find that the relationship between birth date and schooling level is the same as the relationship between birth date and earnings. Again, it appears that an event likely to be independent of the determination of earnings (an individual's date of birth) has influenced both worker schooling levels and worker earning levels in the same direction. This is still further evidence that the relationship between schooling and income results from a causal connection between education and the determination of earnings.

6. Conclusion

I began this lecture with the question, how convincing is the evidence linking education and income? Here is my answer: Pretty convincing. If I had to bet on what an ideal experiment would indicate, I would bet that it would show that better educated workers earn more.

There is, however, a great deal more to be learned about the role of education in the determination of income. For one thing, relatively little is known about how the quality of education determines earnings. This is an area where the experimental method can be used extensively to study the role of class size and other educational innovations on learning. Indeed, it already has been used in Tennessee, where students (and teachers) were randomly assigned to different class sizes within the same schools and then differences in the scores of these students on standardized tests were studied.[8] The results of this experiment, which are strikingly credible in an area dominated by work that is not very credible, indicated that class size was clearly linked to test performance. Whether this result

can be duplicated elsewhere, and whether the costs of such alterations are worth the benefits, are important topics for further research.

Footnotes

1. Prepared for delivery as the George Seltzer Distinguished Lecture, Industrial Relations Center, University of Minnesota, 1991.

2. Orley Ashenfelter is Professor of Economics and Director of the Industrial Relations Section, Princeton University.

3. I am deeply indebted to David Card, Alan Krueger, Thomas Lemieux, and David Zimmerman for discussions and assistance in the preparation of this lecture.

4. See Robert Lalonde, "Evaluating the Econometric Evaluations of Training Programs with Experimental Data," The American Economic Review, September 1986, Vol. 76, No. 4, pp. 604-620.

5. This point is due to Zvi Griliches, "Sibling Models and Data in Economics: Beginnings of a Survey," The Journal of Political Economy, October 1979, Vol. 87, No. 5, Part 2, pp. S37-S64.

6. Joshua Angrist and Alan Krueger, "Does Compulsory School Attendance Affect Schooling and Earnings?," The Quarterly Journal of Economics, November 1991.

7. Joshua Angrist and Alan Krueger, "Estimating the Payoff to Schooling Using the Vietnam-era Draft Lottery," unpublished paper, August 1991.

8. See Project Star, Final Executive Summary Report, June 1991, Tennessee State Department of Education, Nashville, Tennessee.

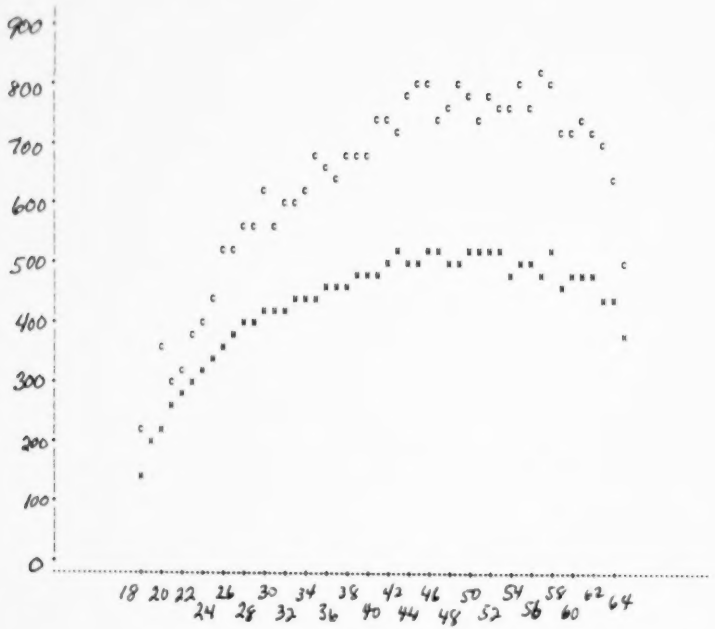
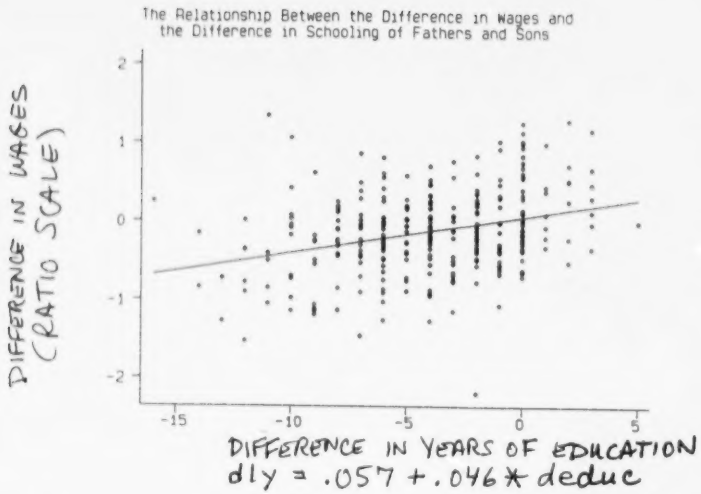


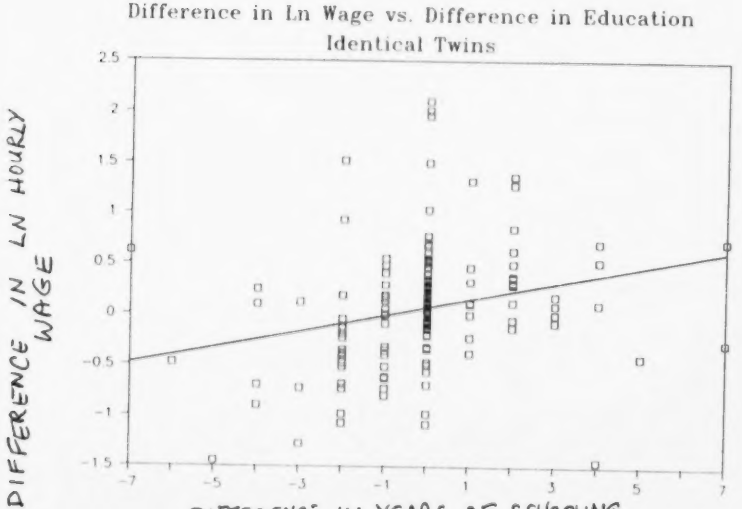
FIGURE 1

H = HIGH SCHOOL
C = COLLEGE



$dly = .057 + .046 * deduc$

FIGURE 2



$d\,Ln\,W = .067 + .068\ d\,Educ$

$(.044)\ (.024)$

FIGURE 3

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ORLEY ASHENFELTER

Orley Ashenfelter is Professor of Economics and Director of the Industrial Relations Section at Princeton University. His areas of specialization include labor economics, econometrics, and the analysis of dispute-settlement systems. He has been Director of the Office of Evaluation of the U.S. Department of Labor (1972-73), a Guggenheim fellow (1976-77), the Benjamin Meeker Visiting Professor at the University of Bristol (1980), a Fellow of the Center for Advanced Study in the Behavioral Sciences (1989), and the Meyer Visiting Research Professor at the New York University School of Law (1990). He edited the Handbook of Labor Economics and is currently the Editor of the American Economic Review. His current research includes the evaluation of the effect of schooling on earnings and several empirical studies of the impact of various dispute resolution systems.

GEORGE SELTZER

George Seltzer earned his B.A. and Ph.D. degrees in economics from the University of Chicago. Prior to his academic career, Professor Seltzer served in the federal government in a variety of posts including: Special Assistant, Office of Defense Mobilization, Executive Office of the President; Executive Director, Economic Stabilization Agency, Special Assistant to the Secretary, Department of Commerce; Economist, Antitrust Division, Department of Justice; and Labor Advisor to the War Production Board.

Professor Seltzer began his service to the University of Minnesota in 1954. In addition to his research and teaching responsibilities with the Industrial Relations Center, he served as the Center's Acting Director and also held posts as Director of the Bureau of Business and Economic Research and Associate Dean for Academic Affairs of the Carlson School of Management.

Professor Seltzer's expertise has been actively sought in the development and implementation of public policy. He was chairman of the Minnesota Public Employment Relations Board for three terms and was its sole public member between 1972-79. He was also Chairman of the Advisory Council to the Minnesota Department of Employment Services for 20 years.

At the end of the 1987-88 academic year, Professor Seltzer became Professor Emeritus of Industrial Relations. He continues his active involvement in the research and teaching program of the Industrial Relations Center consistent with his other broad interests.

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